

CONGENITAL HEART DISEASE IN ONE OF IDENTICAL TWINS

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As so many of the diseases afflicting children have been successfully controlled, attention has been focused increasingly on congenital abnormalities.

The developing embryo can be affected by inherited genetic factors or by the environment, and twins have been much studied to help in the differentiation of these factors. Identical twins, arising from the same ovum, have identical genetic structure, so that differences between them must arise from some difference in the environment.

Formerly, most congenital defects were thought to have a genetic basis, but recently environmental factors have come increasingly into prominence. Despite this, few cases of congenital malformation of the heart in one of a pair of monozygotic twins have been recorded. Such a case is described here with a summary of previously recorded examples.

Case History

Linda was seen at the age of 6 years because a heart murmur had been detected on examination during a mild attack of pneumonia one month previously. As she was a twin, her twin sister, Anne, was also sent for, and the two examined together.

The twins came sixth in the family, the five older siblings being singletons and quite healthy. An uncle of the mother had twins, a boy and a girl, among eight children, and an aunt of hers had girl twins beside two singletons. Whether these girls were identical twins or not is unknown.

The age of both the mother and father at the time of the birth of the twins was 37 years. Both parents were healthy, and the mother was not examined radiographically until the seventh month of pregnancy.

At birth, which was at term, Linda weighed 7 lb., and Anne 5½ lb., and the slight difference in size has been maintained since. Both twins were reared on National Dried Milk, and passed their developmental milestones together at the usual times.

Both children are liable to attacks of tonsillitis from which they suffer almost simultaneously, and both had a mild bout of pneumonia one month before the time of examination.

On examination, Linda weighed 44 lb. and measured 43 in. in height. (Anne 40½ lb. and 42 in.)

They were remarkably similar in appearance (Fig. 1),



FIG. 1.—The twins—Linda on the right.

and the only differences noted were the abnormalities in Linda's cardiovascular system and the fact that Anne was left-handed while Linda was right-handed.

Examination of Linda's heart showed the apex beat to be in the fifth left interspace in the nipple line. The impulse was not remarkable. There was a harsh systolic murmur and thrill maximal in the second left interspace, and the second pulmonary sound was weak. Blood pressure was 110/70. Cardioscopy showed slight enlargement of the right ventricle and dilatation of the pulmonary artery. The lung fields appeared clear. An electrocardiogram showed right axis deviation (Fig. 2a). She was not cyanosed and showed no finger clubbing, and a clinical diagnosis of isolated pulmonary stenosis was made. In contradistinction the heart of Anne was normal on examination. Cardioscopy revealed a normal cardiac outline and the electrocardiogram was also normal (Fig. 2b).

Since first being examined, both girls have remained well apart from tonsillitis.

Evidence of Monozygosity. Unfortunately the midwife who delivered the twins has since died, and no record of the delivery has been preserved. The mother stated that there was but one afterbirth, which, though suggestive, cannot be accepted as conclusive evidence, so further corroboration was sought. Using Newman's (1940) method of similarity, the following points were noted:

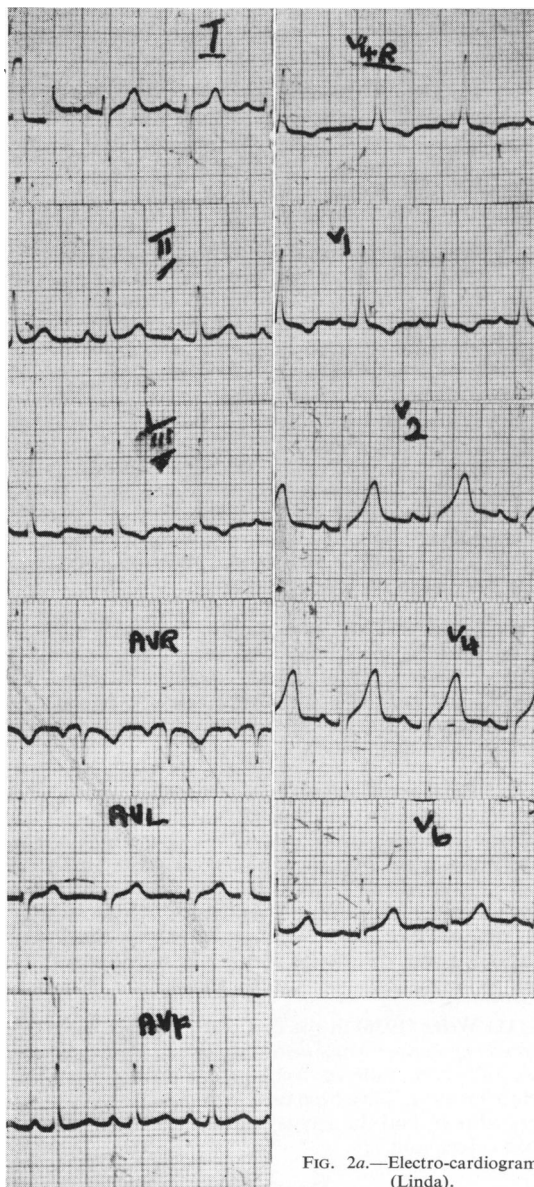


FIG. 2a.—Electro-cardiogram (Linda).

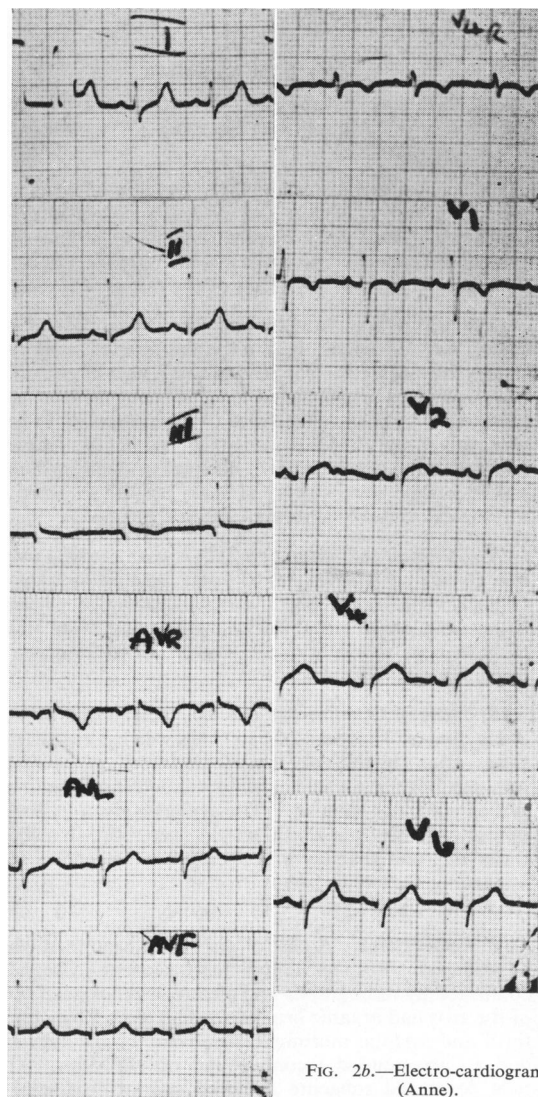


FIG. 2b.—Electro-cardiogram (Anne).

The features were markedly similar. The twins' hair was alike in colour, texture and whorl, as were the eyelashes. The irides were the same colour in the two girls. The lips and ears were similar. The teeth of the two were alike in appearance and time of eruption, except for one carious molar in the case of Linda.

The finger prints were interesting. The impressions of the two were remarkably similar but not identical, and the right hand of Linda resembled more closely the left hand of Anne than her own left hand.

Intelligence tests gave identical results in both girls: an intelligence quotient of 95 on Terman Merrill Form L, and a mechanical reading age (Schonell Graded Word Test) of 5.1 years.

Finally, Dr. W. Weiner, Director of the Birmingham Regional Blood Transfusion Service, kindly examined the blood of each twin, which was found to be Group AB, Rhesus negative, cdE/cde, M positive, Kell negative, in both children. He also examined the blood of the parents, siblings, two uncles, an aunt and the maternal

grandmother. He concluded from these blood studies that the degree of probability of the twins being identical was 96.4%.

On this evidence there seems no doubt that the children are indeed one egg twins.

Cases in the Literature

The following instances of congenital heart disease, recorded as occurring in one egg twins, have been found in the literature:

(1) **Forsyth and Uchida (1951).** A pair of 6-year-old girl twins, one of whom had an auricular septal defect diagnosed clinically and by cardiac catheterization. The evidence of monozygosity was incontrovertible and better documented than in any other of the recorded instances.

(2 and 3) **Wade (1952).** The first was a pair of girl twins, one of whom had a patent ductus arteriosus successfully ligated. The second was a pair of girl twins, one of whom was considered to be suffering from isolated pulmonary stenosis. Evidence of monozygosity in each pair was a marked similarity in numerous features. Moreover, the finger prints of each set of twins, although not identical, were closely similar, and there were no serological differences in the blood of each pair.

(4) **Goldman and Stern (1952).** A pair of male twins, one of whom, when aged 10 years, was considered on clinical, radiological and electrocardiographic evidence to have an atrial septal defect. The twins were stated to have been monochorionic, and no other evidence of monozygosity was given.

(5) **Jeune and Confavreux (1948).** The second of male twins died at 11 weeks of age. He was cyanosed from soon after birth. Necropsy disclosed a persistent foramen Botalli, a ventricular septal defect and pulmonary infundibular stenosis. The evidence given in favour of monozygosity was that the twins were born in a single water sac, and that there was only one placenta. It is interesting that they had mirror image irregularities of the ears and palm prints (poor prints).

(6) **Kean (1942).** A pair of girl twins, examined when 18 years old. Both had complete situs inversus visceralis, confirmed by radiographs and electrocardiograms. One of the girls had organic heart disease as shown by a harsh thrill and systolic murmur to the right of the sternum, and an accentuated second sound on the right. This twin developed subacute bacterial endocarditis, caused by *Streptococcus viridans*, from which she subsequently died. Permission for necropsy was refused, but the author considered that she had suffered from congenital and not rheumatic heart disease. Evidence that they were a pair of one egg twins appears to be satisfactory. Although there were two placentas, this may happen when the twinning division takes place unusually early. Otherwise the similarity points described by Newman were well satisfied.

Although the evidence given in these six examples is not always complete, there seems little doubt that each

pair was identical. There are, however, a few case records which, for one reason or another, cannot be definitely accepted.

(7) **McClintock (1945).** A female infant, the second of twins, birth weight 4½ lb., died on the fourth day. Necropsy revealed a patent ductus arteriosus and coarctation of the aorta. The other twin girl survived and was clinically normal. The only evidence of monozygosity was the presence of one placenta.

(8) **Dubreuil-Chambardel (1927)** described briefly a pair of twins ('identité parfaite'), one of whom had complete situs inversus visceralis, confirmed radiologically. In addition, each twin had mirror-image hare lip. Most subsequent authors have quoted this pair as an example of congenital heart disease in one of identical twins, but 'mirror imaging' in varying degree was stated by Newman to occur in about one quarter of one egg twins, although situs inversus was considered to be rare. He suggested that such a reversal might be accounted for by the twinning division occurring late in development when the two half embryos had become different in their rates of development and dominance was already present. It would seem therefore that the dextrocardia in this case was inherent in the twinning process.

(9) **Reinhardt (1912)** gave good evidence that a pair of twins aged 20 years, who were examined for military service, were identical. Both had dextrocardia. On clinical and radiological evidence one was regarded as having some organic cardiac lesion, type unspecified, and he was given light duties.

(10) **Pezzi and Carugati (1924)** described young adult twins, considered to be identical, both of whom were said to have isolated dextrocardia. The evidence is confusing (for instance the liver in one of them was stated to be palpable on the left side), but the published electrocardiograms of both twins were typical of dextrocardia. In view of Newman's writings on mirror imaging in identical twins, mentioned above, one might regard this pair as having dissimilar cardiac status.

(11) **Weitz (1936)** in the first edition of his book, *Die Vererbung innerer Krankheiten*, described identical twins, one of whom suffered from patent ductus arteriosus. Unfortunately I have been unable to obtain a copy of this first edition, and the second edition (1949) contains no such description.

Discussion

Reading the case records of the patients cited above, one is not always certain whether the twins were of the one or two egg variety. Newman (1940) stated that if the pair are similar in appearance, and in such points as hair texture, colour and whorl, colour of eyes, shape of lips and ears, eruption and appearance of teeth, appearance of eyebrows and eyelashes, and similarity of palm and finger prints, then it is practically certain that the pair are one egg

twins. Two egg twins who are much alike always have definite differences in some of these features. The diagnosis of monozygosity by examination of the foetal membranes is not considered infallible to-day, but, if careful examination shows the presence of only one chorion, then the one egg type of twins can be assumed.

In some of the patients, the type of heart disease is not known for certain. However, it seems probable that the first six cases fulfil the requirements necessary for a diagnosis of congenital heart disease in one egg twins. Four of the remaining five are not considered completely acceptable, usually because of insufficient evidence as to the type of twinning and the kind of heart disease. The final case has not been traced.

The type of heart lesion found was varied, and these examples provide evidence of the importance of

environment in the causation of congenital heart disease.

Summary

A case of congenital heart disease in one of a pair of identical twins has been described.

A brief account of other recorded examples has been given.

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